The Patent Office

PCT/GB 2003 / 0 0 5 3 1 6

INVESTOR IN PEOPLE

REC'D 26 JAN 2004

WIPO

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated 5 January 2004

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

BEST AVAILABLE COPY

Patents Form 1/77

Patents Act 1977
(Rule 16)

THE PATENT OFFICE
C[redacted]
11 JUN 2003
RECEIVED BY FAX

The Patent Office (PATENTS • DESIGNS • COPYRIGHT • TRADE MARKS)

11JUN[redacted]14241-1 D02802
P01/7[redacted].00-0313474.9

1/77

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1.	Your reference	AW/SEB/P/76009.GB/B
2.	Patent application number *(The Patent Office will fill in this part)*	11 JUN 2003 — 0313474.9
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	INCRO LIMITED 35 Fairfield Rise Wollaston Stourbridge West Midlands DY8 3PQ
	06463632001 Patents ADP number *(if you know it)*	
	If the applicant is a corporate body, give the country/state of its incorporation	United Kingdom
4.	Title of the invention	IMPROVEMENTS IN OR RELATING TO NOZZLE DEVICES
5.	Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	WILSON GUNN SKERRETT CHARLES HOUSE 148/9 GREAT CHARLES STREET BIRMINGHAM B3 3HT UNITED KINGDOM
	Patents ADP number *(if you know it)*	7710734001

		Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number			

		Number of earlier application	Date of filing *(day / month / year)*
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application		

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
   c) any named applicant is a corporate body.
   See note (d))

   Yes (a)

0071453 11-Jun-03 04:37

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	45
Claim(s)	CF
Abstract	
Drawing(s)	13 only

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this applicatior

Signature Andrew Wells. Date 11 June 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

Dr A Wells
0121 236 1038

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publicatior or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

f) *For details of the fee and ways to pay please contact the Patent Office.*

0071453 11-Jun-03 04:37

IMPROVEMENTS IN OR RELATING TO NOZZLE DEVICES

The present invention relates to improvements in or relating to nozzle devices. More particularly, the present invention relates to a pump-action nozzle device adapted to be fitted to the opening of a container to provide a means by which the contents stored therein can be dispensed through the opening of the container. It shall be understood that the term "pump-action" is used herein to refer to nozzle devices which contain a manually operable pump, the operation of which causes the contents stored in the container to which the device is fitted to be dispensed through a nozzle outlet under pressure.

Conventional pump-action nozzle devices fall within two general categories, namely the so-called trigger nozzle devices and the so-called pump nozzle devices. The former category includes devices where the pump-action is mediated by pulling and then releasing a trigger provided as a component of the device, whereas the latter category includes devices where the pump-action is mediated by an operator directly pressing and then releasing a resiliently mounted portion of the nozzle device. Pump nozzle devices are also commonly referred to as finger pumps because they are adapted to enable the operator to operate the device with their finger. In both cases, the operation of the trigger or the pump generates a pressure within the device which forces a proportion of the contents of the container to which the device is attached to be dispensed through a nozzle outlet of the device..

0071453 11-Jun-03 04:37

Although such devices provide a convenient means by a products stored in a container can be dispensed, there are a number of problems associated with conventional pump-action nozzle devices. Firstly, the conventional devices tend to be extremely complex in design and often comprise numerous different components (on average, 12 individual components in pump nozzle devices and between 10 and 14 individual components in trigger nozzle devices). As a consequence, these devices are costly to manufacture due to the amount of material required and the assembly processes involved. Secondly, the conventional devices tend to be bulky, which again contributes to the cost constraint arising as a consequence of the amount of material that is required to manufacture the device. Thirdly, a proportion of the bulk of the conventional pump devices resides inside the container to which the device is attached. This creates a drawback in that the nozzle device takes up a proportion of the internal volume of the container, which can be a particular problem in small containers. Finally, the size of the pump device is also restricted in small containers with narrow necks and this limits the amount of pressure that can be generated by the device, which can again be detrimental to the performance of the device. One solution to this latter problem is to increase the height of the pump nozzle device, but with small containers this creates further problems in that, in addition to being unsightly, it becomes difficult for an operator to hold the container in their hand and also operate the pump with their finger.

0071453 11-Jun-03 04:37

Therefore, there is a desire for a pump-action nozzle device which is simpler in design, utilises less components and is generally less bulky than the conventional pump-action nozzle devices.

The present invention seeks to address the aforementioned problems associated with conventional pump-action nozzle devices by providing, in a first aspect, a pump-action nozzle device adapted to be fitted to an opening of a container and enable the contents stored in said container to be dispensed through said opening, said device comprising:

(i) a base;

(ii) a housing mounted to said base, said housing defining an internal chamber together with said base and further comprising a nozzle outlet;

(iii) a first valve disposed between said chamber and the interior of the chamber to which the device is fitted;

(iv) a second valve disposed between the chamber and the nozzle outlet defined by said housing;

said device being operable in a first stage of operation to cause the contents of said container to be drawn into the chamber of the device from the interior of the container to which it is fitted through said first valve, and, in a second stage of operation, to cause the contents of the chamber to be ejected from said

0071453 11-Jun-03 04:37

device by causing said contents to flow through said second into the nozzle outlet;

wherein said first stage of operation is facilitated by the movement of said housing relative to the base so as to cause the internal volume of said chamber to expand, thereby creating a reduced pressure within said chamber relative to the interior of the container which causes the second valve to close and the first valve to open and the contents of said container to flow from the container into the chamber, and said second stage of operation is facilitated by the movement of the housing relative to base so as to cause the chamber to be compressed, thereby increasing the pressure within the chamber relative to the external environment of the device and causing the first valve to close and the second valve to open and the contents of said chamber to be dispensed from the chamber and through the nozzle outlet.

When compared to conventional pump-action nozzle devices, the devices of the present invention are simpler in design/construction and comprise a reduced number of components. This provides significant cost savings by reducing the amount material required to manufacture the devices, as well as reducing the construction/assembly costs. Furthermore, in preferred embodiments of the invention, the bulk of the device can be significantly reduced and the chamber can be positioned outside the container, thereby enabling the device to be fitted to the openings of containers of virtually any size, without the amount of pressure that can be generated being influenced by

0071453 14-Jun-03 04:37

the size of the container and the constraints that this would impose of the dimensions of the device (as is the case with conventional pump nozzle devices).

The housing of the device may be one integrally formed component or, alternatively, may be formed of multiple component parts that are fitted together to form the housing. Preferably the housing comprises two parts. Most preferably, the housing comprises a main body part and a lid which is fitted to the housing and, together with the main body of the housing, forms the second valve and the nozzle outlet.

Preferably, the housing is slidably mounted within a recess formed in an upper surface of the base to enable the housing to be moved relative to the base to vary the internal volume of the chamber during the operation of the first and second stages of operation of the device.

Preferably, the chamber of the device further comprises a plunger. The function of the plunger is primarily to enable virtually the entire contents of the chamber to be expelled during the second stage of the operation of the device of the invention. To enable the plunger to perform this function it must form a seal with the sides of the chamber formed by the internal walls of the housing. Preferably, the plunger forms two seals with the wall of the chamber, namely a first seal which prevents the product leaking past the plunger during the second stage of operation and a second seal which prevents air being drawn into the

0071453 11-Jun-03 04:37

chamber (instead of the contents of the container) during the first stage of operation of the device. Furthermore, the sealing contact or contacts must be maintained while the housing is moved relative to the base to facilitate the expansion and/or compression of the chamber. The plunger may be fixed to the housing within the chamber so that when the housing moves relative to the base during the operation the device, the plunger also moves. Preferably, however, the plunger is seated on an upper surface of the base of the device so that the space within the chamber is defined between said plunger and the internal walls of the housing. In addition, it will be appreciated that the plunger will remain in this position within the chamber as the housing is moved relative to the base during the operation of the device. The plunger may be made from any suitable material, such as rubber or plastics materials, for example. The plunger may be integrally formed with the base, but is preferably a separate component formed of a different material to that of the base.

The base is preferably adapted to enable the device to be fitted to an opening of a container. In a preferred embodiment, the base comprises a cavity adapted to receive a correspondingly neck of the container which defines the opening of the container. The neck may be secured in the cavity by any suitable securing means. Preferably, the base is a screw top which can be fitted to an opening of the container (i.e. the neck of the container is provided with a screw thread that is adapted to screw into a groove formed in the internal wall of the base, or vice versa).

0071453 11-Jun-03 04:37

The first valve may be any suitable valve assembly which enables the contents of the container to flow into the chamber of the device during the first stage of operation of the device, but which prevents flow in the other direction during the second stage of operation of the device. In certain embodiments of the invention, the plunger is seated on the upper surface of the base and comprises valve member or stem which extends downwards from the main body of the plunger and is received in a sealing engagement with a valve seat formed in the base. In alternative embodiments, the valve member or stem may be a separate components, i.e. it is not integrally formed with the plunger. During the first stage of operation, the valve member or stem is displaced from the valve seat to form an opening through which the contents of the container may flow into the chamber of the device.

The second valve between the chamber and the nozzle outlet may also be any suitable valve assembly which opens when the contents of the chamber are compressed during the second stage of the operation of the device, but which closes during the first stage of operation to prevent air being drawn into the chamber through the nozzle outlet. Preferably, the second valve requires the minimum threshold pressure to be attained within the chamber before the valve will open. For example, the contents of the chamber may be ejected at a pressure of 6 bars and in such cases the second valve may be provided with a minimum threshold pressure of 5 bars. The second valve could be a ball valve, for example, where the ball is displaced to open the valve when the pressure

0071453 11-Jun-03 04:37

within the chamber exceeds a predetermined minimum threshold. In a preferred embodiment of the invention, however, the second valve is a flap valve in which the flap is resiliently mounted so as to reside in a position in which a channel between the chamber and nozzle outlet is closed (i.e. the valve is closed), but may be distended to a position in which said channel is open (i.e. the valve is open) when the pressure within the chamber exceeds a predetermined maximum.

In an especially preferred embodiment, the second valve comprises a channel opening between the chamber and the nozzle outlet which is closed by a resiliently deformable membrane. The resiliently deformable membrane may be made from any suitable resiliently deformable material, such as plastic or rubber. The membrane is configured so that it covers the opening formed in the wall of the chamber and will only deform to form an opening between the chamber and the nozzle outlet when the pressure within the chamber exceeds a predetermined minimum threshold. In preferred embodiments, the resiliently deformable membrane is formed in a lid which is fitted to, and forms a constituent part of, the housing.

Any suitable nozzle outlet may be used in the devices of the present invention. In particular, the nozzle outlet may be adapted to generate a spray of the contents of the container passing through it or, alternatively, it may be an outlet channel through which more viscous fluids, such as soaps, creams and mousses etc. may be dispensed.

0071453 11-Jun-03 04:37

Preferably, the nozzle outlet is formed from two parts, each respective part having an abutment surface having recesses or grooves formed therein which, when the abutment surfaces are brought into contact with one another, define an inlet, an outlet and a fluid flow passageway which connects said inlet to said outlet. The respective parts, once formed, may be permanently fixed together by, for example, ultrasonic welding, or alternatively, the parts may be releasably connectable to one another. This latter form of assembly is preferred because it enables the respective parts to be separated to expose the inlet, outlet and fluid flow passageway of the nozzle outlet for cleaning.

Preferably, one of the parts is the main body of the housing of the device and the other (second) part may be in the form of lid or cap which is fitted to the housing and together with the main body of the housing form the nozzle outlet thereof. In certain embodiments of the invention, the second part may also form the resiliently deformable membrane of the second valve, as mentioned above. Examples of nozzle arrangements formed of two separate parts are described in WO 01/89958 and W0 97/31841, and the entire contents of these documents are incorporated herein by reference.

In order to prevent the container collapsing as the device of the present invention is used, it is preferable that the device comprises an air leak valve, to enable air in the external environment to access the interior of the container to equalise any pressure differential that exists between them. Any suitable form of air leak would suffice. Preferably, however, the air leak valve is a one-way

0071453 11-Jun-03 04:37

valve, which enables air to flow into the container from the outside, but prevents flow in the opposite direction and hence, prevents any product in the container from leaking out through the air leak valve if the container is inverted, for example. Illustrative examples of suitable air leak valve arrangements formed in the device of the present invention are described below in reference to Figures 9A, 9B and 9C.

Preferably, the device further comprises resilient means disposed between the base and the housing. The resilient means preferably acts to urge the housing and the base apart, i.e. into a position in which the internal volume of the chamber is expanded to, or nearly to, its maximum. Preferably, the resilient means is a spring disposed within the chamber that is biased at one end against the base and, at the other end, against the housing of the device.

In use, an operator wishing to dispense the contents of the container can apply pressure to the housing of the device against the action of the spring and thus, cause chamber defined therebetween to compress and the contents of the chamber to be dispensed through the nozzle outlet. Once the pressure applied by the operator to the housing has been released, the spring urges the housing and the base apart and thus causes the contents of the container to be drawn into the chamber of the device ready for the next actuation by the operator.

Preferably, a dip tube is fitted to the base to enable a product stored in the container to be drawn into the device from the interior of the container.

0071453 11-Jun-03 04:37

For certain applications, it is desirable to co-eject air together with the contents of the container passing through the nozzle outlet. For instance, the air could be mixed with the product to impart a certain consistency to the product, as is the case with certain foams or mousse products for example, or an air stream could be used to atomise droplets of fluid passing through the nozzle outlet. For this latter application it is especially desirable to be able to introduce an air stream at a predetermined location along the length of the fluid flow passage of the nozzle outlet. Hence, in certain embodiments, the chamber of the device is divided into two separate compartments, a first compartment which is provided with the first and second valves to enable the contents of the container to be drawn into the first compartment and dispensed through the nozzle outlet during the respective first and second stages of operation, and a second compartment which is a separate air compartment. Hence, the movement of the housing relative to the base to cause the compression of the chamber during the second stage of operation in such embodiments causes the contents of the container to be dispensed through the nozzle outlet in the usual manner, but also forces air from the second compartment though an outlet channel into the nozzle outlet, where the mixing of the air with the contents of the container passing through the nozzle outlet occurs. In a preferred embodiment, the nozzle outlet has a fluid flow passage which is separated from the fluid flow passage by a wall and the outlet channel is a hole formed in said wall between the chamber and the fluid flow passage. In certain embodiments,

0071453 11-Jun-03 04:37

the outlet channel may be provided with a valve which functions in a similar manner to the second valve discussed above.

Preferably, during the first stage of operation of the device, air is drawn into the air chamber from the external environment through a one-way air inlet valve which allows air to access the air compartment of chamber when the pressure in the chamber is decreased relative to that of the external environment, i.e. when the volume of the chamber is increased by moving the housing and the base apart, but prevents the flow of flow in the opposite direction during the second mode of operation. The air may be drawn into the air compartment through the nozzle outlet and/or through gaps formed between the housing and the base through which the air may flow.

Preferably, the first compartment comprises a plunger as discussed above and the second air compartment is also provided with an air plunger. Preferably, the air plunger is adapted to form a seal with the housing which prevents the air present in the air compartment from leaking past the air plunger during the second stage of operation, but which allows air to flow past during the first stage of operation.

In a preferred embodiment, the air inlet valve also functions as the air release between the interior of the chamber and the external environment.

The device of the present invention may also be provided with a trigger actuator which enables the first and second stages of operation to be facilitated

0071453 11-Jun-03 04:37

by the operation of a trigger, rather than applying pressure to the housing directly. The trigger actuator is preferably configured so that, when the trigger is pulled, the housing of the device is caused to move relative to the base and compress the chamber of the device, thereby causing the contents stored therein to be dispensed through the nozzle outlet, whereas when the trigger is released the housing is caused to move relative to the base so as to cause the volume of the chamber to expand and thereby draw more product (and air if an air compartment is present) into the chamber.

Preferably, the trigger actuator is a separate component that is fitted to the pump-action nozzle device and which comprises a trigger and a mounting. Preferably, the mounting is fixed to the base by one attachment element and the housing by another attachment element and is configured so that when the trigger is pulled the two attachment elements are brought closer together and when the trigger is released, the two attachment elements move further apart. Hence, when the trigger is pulled, the housing is caused to move towards the base and thus compresses the chamber causing the contents of the chamber to be dispensed, whereas when the trigger is released, the housing returns to its original position and the volume of the chamber expands. Preferably, one attachment element is integrally formed with the trigger and is pivotally attached to the base of the device and the other attachment element, the other attachment element being pivotally mounted to the housing of the device.

0071453 11-Jun-03 04:37

According to a second aspect of the present invention there is provided a trigger actuator adapted to be fitted to a pump nozzle device comprising an internally compressible chamber formed between a housing and a base of the device, said housing being moveable relative to the base to facilitate the expansion of the internal chamber in a first stage of operation and the compression of the chamber in a second stage of operation, said trigger actuator comprising a trigger and means by which the trigger actuator may be connected to the base and means by which the trigger actuator may be attached the housing, wherein said trigger actuator is configured so that when the trigger is pulled towards the nozzle device said housing is caused to move relative to the base and compress the chamber during the second stage of operation and when said trigger is released said housing is caused to move relative to the base to expand the chamber during the first stage of operation.

Thus, the trigger actuator provides a means by which a pump nozzle device may be converted into a trigger actuated pump-action nozzle device.

The trigger actuator is preferably formed as discussed above, i.e. it comprises a manually operable trigger that is connected to the base of the nozzle device by an attachment element and the housing by another attachment element, said elements being moveable towards each other when the trigger is pulled and moveable apart from each other when the trigger is returned to its original position. Preferably, the housing is resiliently mounted to the base so

0071453 11-Jun-03 04:37

that the trigger returns to its original "non-actuated or pulled" position automatically when it is released.

According to a further aspect of the present invention there is provided a nozzle arrangement adapted to be fitted to the outlet valve of a pressurised container to actuate the release of a pressurised fluid stored in said container, said nozzle arrangement comprising:

(i) an actuator, the operation of which actuates the release of fluid stored in the container;

(ii) an inlet through which fluid ejected from the container following the operation of the actuator accesses the nozzle arrangement and flows to an outlet through which the fluid is ejected

wherein said nozzle arrangement further comprises a pump-action dispenser adapted to dispense a second fluid, such as air, from said nozzle arrangement when the actuator of the nozzle arrangement is operated.

The expression "pump-action dispenser" is used herein to refer to any pump or trigger dispenser arrangement capable of dispensing a second fluid through the nozzle arrangement. Such nozzle arrangements preferably comprise a compressible chamber having an outlet valve and an inlet valve, said outlet valve being adapted to permit a fluid present in the chamber, such as air, to be dispensed through an outlet of the chamber when the compressible chamber is compressed so that the pressure therein exceeds a predetermined

0071453 11-Jun-03 04:37

minimum threshold pressure, said inlet valve being adapted to permit fluid to be drawn into the chamber from a source when the chamber expands. Thus, compression of the chamber causes fluid to be ejected when the pressure exceeds a predetermined minimum threshold valve (which will vary depending on the application) and the subsequent expansion of the chamber once the compression force has been removed causes more fluid to be drawn into the chamber from a supply source.

The compressible chamber is preferably positioned in the body of said nozzle arrangement so that the operation of the actuator directly compresses the chamber, as well as actuating the release of the contents of the pressurised container. The compression of the chamber may be facilitated by any suitable means known in the art. In certain preferred embodiments, the actuator is operated by the direct application of pressure by the operator, such as a finger press, for example. Alternatively, the actuator may be in the form of a trigger, which is pulled by the operator to actuate the release of the fluid contents present in the container and the compressible chamber. In such embodiments, the actuator is configured so that the application of a pressure by the operator compresses the pump chamber and also engages the outlet valve of the pressurised container to thereby causing the valve to open and fluid present therein to be ejected into the inlet of the nozzle arrangement.

0071453 11-Jun-03 04:37

Preferably, the nozzle arrangement is in the form of a spray through cap, which adapted to be fitted to the end of a hand-held pressurised aerosol canister.

The supply source of the second fluid which is dispensed through the pump-action dispenser may be the external environment in embodiments where the second fluid is air (i.e. the external air is drawn directly into the chamber through the inlet valve). In other embodiments, the second fluid may be drawn from a separate storage compartment, which may be formed in the body of the pressurised container or the nozzle arrangement. The latter is especially desirable in situations where the quantity of the second fluid ejected is low. In addition, in embodiments in the form of a spray-through cap fitted to an aerosol canister the storage compartment may be housed within the confines of the body of the nozzle arrangement and thus, does not necessarily increase the size of nozzle arrangement *per se*.

The second fluid ejected from the compressible chamber may mix with the fluid ejected from the pressurised container at the outlet or at a position along the length of a fluid flow passageway connecting the inlet to the outlet. Alternatively, the pump-action dispenser may be provided with its own independent outlet so that the fluid from the pump-action dispenser and the pressurised container mix outside of the nozzle arrangement. In embodiments where air is the second fluid, it shall be appreciated that the air stream generated from the pump-action device can mix with and atomise the droplets

0071453 11-Jun-03 04:37

of fluid passing through the nozzle arrangements. This atomisation can vastly enhance the quality of the spray generated at the outlet.

Preferably, the predetermined minimum threshold pressure of the outlet valve is selected so that the second fluid present in the chamber is only ejected at the same time, or shortly before the outlet valve of the container is opened. This ensures that the fluid from the pressurised container and the pump-action dispenser are co-ejected together.

Especially preferred embodiments of the invention where the nozzle arrangement has a body that defines a preferred form of the pump-action dispenser is described further below.

In such embodiments the body defines an internal chamber having an inlet valve through which fluid may be drawn into said chamber and an outlet valve through which fluid present in the chamber may be expelled from the nozzle arrangement, wherein at least part of the body which defines said chamber is resiliently deformable so as to enable the chamber to be deformed from an expanded configuration to a compressed configuration by the application of a pressure, thereby causing the volume of said chamber to decrease and the fluid present in said chamber to be expelled through said outlet, and to enable the chamber to be subsequently returned to the expanded configuration by the removal of the applied pressure, thereby causing the volume of the chamber to increase and cause fluid to be drawn into said

chamber through said inlet. Any suitable one-way valve assembly that is capable of forming an airtight seal may be provided as the outlet valve. Preferably, the outlet valve consists of a passageway formed between two abutting surfaces, at least one of which is resiliently deformable. The abutting surfaces are adapted to normally be in tight abutment and thus, render the outlet passageway closed. However, when the pressure is increased in the chamber above a predetermined minimum pressure, the resiliently deformable abutment surface deforms away from the opposing abutment surface to define an open passageway through which fluid can flow. The predetermined minimum pressure that is required will depend on the application concerned and a person skilled in the art will appreciate how to modify the properties of the resiliently deformable surface by the selection of an appropriate resiliently deformable material and varying the manner in which the surface is fabricated (e.g. by the inclusion of strengthening ridges).

It is especially preferred that the resiliently deformable abutment surface, which forms at least a part of the outlet passageway, is integrally formed with the resiliently deformable portion of the body, which defines the chamber.

As indicated above, the outlet valve preferably only permits fluid to flow through the outlet when the pressure of the fluid in the chamber exceeds a predetermined minimum value (an effect known as "pre-compression"). In an alternative embodiment, the outlet may be an outlet passageway or channel in

0071453 11-Jun-03 04:37

which an outlet valve is positioned. The outlet valve is such embodiments is preferably a resiliently deformable flap positioned within the outlet channel, which is configured to be distended to permit fluid to flow out of the chamber through the outlet when the pressure therein exceeds a predetermined minimum threshold value and close the outlet channel at all other times. The resiliently deformable flap is preferably positioned within a further chamber disposed along the length of the outlet channel. The resiliently deformable flap is positioned within the chamber so that it covers the inlet to the further chamber, but can distend away from the inlet when the pressure therein exceeds the predetermined minimum threshold. It is especially preferred that the resiliently deformable flap is formed as an extension of the resiliently deformable portion of the body. The resiliently deformable flap may be made from resiliently deformable material, such as plastic or rubber, a semi-flexible plastic material, or a rigid plastic material provided with a resiliently deformable hinge to permit movement between a position in which the passageway is open and a position in which the passageway is closed.

In certain embodiments, the fluid passing though the outlet valve at or above the predetermined pressure may be directed into a spray nozzle passageway, which is fitted downstream to the outlet valve. The spray nozzle passageway preferably consists of two parts prepared from a rigid plastic material, although it may also be formed from a flexible/resiliently deformable or semi-flexible plastic material or a combination of a flexible/resiliently

0071453 11-Jun-03 04:37

deformable and a rigid plastic in some cases. Each respective part of the spray nozzle passageway preferably comprises an abutment surface which is provided with grooves and/or recesses formed thereon which, when the abutment surfaces contacted together to form the final spray nozzle passageway, align to define an internal passageway through which fluid passing through the outlet valve can travel prior to being ejected through an outlet orifice in form of a spray. The spray nozzle passageway may optionally comprise one or more internal features adapted to modify the properties of the fluid passing through so as to form a spray having the required droplet characteristics (e.g. droplet size distribution, droplet dispersion etc.). Examples of internal features that may be present include one or more expansion chambers, one or more swirl chambers, one or more internal spray orifices, and one or more venturi chambers. These aforementioned features, and the effect that they impart on the properties of the spray produced, are discussed in WO 01/89958, the entire contents of which are incorporated herein by reference. It shall be appreciated that the provision of the "pre-compression" ensures that the fluid enters the spray nozzle passageway with enough force to generate the required spray.

The spray nozzle passageway may be in the form of a separate unit, which can be inserted into the outlet end of the outlet valve of the chamber to form the outlet of the nozzle arrangement or, more preferably, the spray nozzle passageway may be integrally formed with the body of the nozzle arrangement. The spray nozzle arrangement may also be hinged so as to enable it to be

0071453 11-Jun-03 04:37

optionally swung into the required position for use and swing out of position when it is not required.

The resiliently deformable material which forms at least a portion of the body defining the chamber and, in preferred embodiments, also forms the resiliently deformable abutment surface of the outlet valve through which fluid ejected from the chamber passes before entering the spray nozzle passageway, may also extend over the spray nozzle passageway assembly to provide a sealant coating thereto. Alternatively, the resiliently deformable abutment surface of the outlet passageway/valve may stop at the opening to the spray nozzle passageway instead of extending over it. This latter construction enables the two parts of the spray nozzle passageway to be readily accessible so that the two parts can be separated for cleaning, as discussed in WO 97/31841, the entire contents of which are incorporated herein by reference.

Any suitable resiliently deformable material, such as a resiliently deformable plastic or rubber, may be used in the preparation of the nozzle arrangement of the present invention. In addition, the term "resiliently deformable" is also used herein to encompass rigid plastics materials, which are configured in such a way that a resilient deformation may still occur when a pressure is applied (i.e. when the pressure is removed, the material will then return to its original configuration). In other words, the device could be prepared from a standard material such as rigid polypropylene, provided the

0071453 11-Jun-03 04:37

device is configured to enable the resilient deformation of a part of the body defining the chamber.

Preferably, the edge of the resiliently deformable material, and the resiliently deformable abutment surface in embodiments where the resiliently deformable material forms an abutment surface of the outlet passage/valve, are made very thin, i.e. preferably of the order of 2-5 millimetres thickness. It is also preferable that the "outlet" end of the channel is thickened to form a tight seal. This enables the outlet passageway to seal preferentially at the "outlet" end and any matter retained in the channel will be sucked back towards the chamber. This reduces any dribbling or foaming of product at the outlet that may otherwise occur after use.

If the flexible and resiliently deformable part of the outlet passageway/valve is made from a thin plastic material, the resistance may not be sufficient to provide the required minimum pressure threshold. In such cases, a thickened rib of resiliently deformable material, which extends across the passageway, may be provided to provide the necessary strength and resistance in the outlet passageway/valve. Alternatively, a rigid reinforcing rib could be provided above part of the outlet passageway/device.

Alternatively, the outlet valve may be a resiliently deformable flap provided in an outlet chamber, which is positioned in the outlet passageway. The resiliently deformable flap is preferably configured so that it blocks the

0071453 11-Jun-03 04:37

outlet passageway when the pressure is below a predetermined minimum threshold value, and deforms to open the passageway when the pressure within the chamber, and hence, the outlet passageway, exceeds the minimum threshold value. The flap may be made from a resiliently deformable material entirely, or may possess a resiliently deformable hinge, which deforms when the required level of pressure is applied to the body of the flap. Preferably, the flap is positioned over the inlet to the chamber.

Preferably, the inlet valve is a flap valve consisting of a resiliently deformable flap positioned over the inlet, which is adapted to deform so as to allow fluid to be drawn into the chamber through the inlet when the chamber returns from the compressed to the expanded configuration, but covers and closes off the inlet at all other times, thereby preventing fluid flowing back from the chamber into the inlet. It is especially preferred that the resiliently deformable flap is formed as an integral extension of the resiliently deformable portion of the body which defines the chamber.

The pump-action device may comprise two or more separate chambers. Each individual chamber may draw fluid into the nozzle arrangement through a separate inlet and from different compartments within the same container. Alternatively, one or more of the additional chambers may draw air in from outside the nozzle arrangement. Whether the additional chamber or chambers contain air or some other fluid drawn from a separate compartment within the container, the contents of the two or more chambers can be ejected

simultaneously through the outlet by compressing both chambers together. The contents of the respective chambers will then be mixed within the nozzle arrangement, either on, or prior to, mixing with the fluid ejected from the pressurised container. It shall be appreciated that varying the relative volumes of the separate chambers can be used to influence the relative proportions of constituents present in the final mixture expelled through the outlet. Furthermore, the outlet valves from each compartment can feed fluid into separate channels, and each separate channel may feed fluid into a spray nozzle passageway as discussed above where it is mixed prior to ejection.

The chambers may be arranged side by side or one chamber may be on top of another.

When two or more separate compartments are present in the pump-action dispenser of the nozzle arrangement, it is problematical getting the outlet valve of each chamber to open at the same time. For this reason, it may be preferable that the arrangement is configured so as to enable the application of a pressure to the resiliently deformable portion of the body to facilitate the distortion/opening of the outlet valves at a predetermined point or time.

The body may be made from a semi-flexible plastic. By "semi-flexible" we mean a plastic material that is rigid in nature, but which can be resiliently deformed from its original configuration by the application of a gentle manual pressure and subsequently returned to its original configuration once the

0071453 11-Jun-03 04:37

applied pressure is removed. Such "flexible yet rigid" plastic materials are used, for example, in the preparation of shampoo bottles or shower gel containers. The flexibility/resilience of a semi-flexible material is governed in part by the thickness of the section concerned. In the fabrication of a nozzle arrangement of the present invention, the base may be formed from thicker sections of plastic to provide the required rigidity, whereas the upper part may be composed of thinner sections of plastic to provide the necessary deformability characteristics. If necessary, a framework of thicker sections, generally known as support ribs, may be present if extra rigidity is required in certain areas.

Alternatively, the body of the nozzle arrangement may consist of a rigid part and a separate resiliently deformable part. In such cases it is preferable that the rigid part is a base part and the resiliently deformable part is an upper part. The base part is adapted to be fitted to the opening of a container by a suitable means, for example it may be in the form of a spray-through cap that can be fitted onto the end of a pressurised canister. The upper part is made, at least in part, from a resiliently deformable material, which is moulded so as to enable the upper part to be fitted to said base part to define, together with said base part, the chamber of the pump-action dispenser and also provide an opposing abutment surface of the outlet valve. Preferably, the upper part also extends within said chamber to form a resiliently deformable flap, which covers the inlet to the chamber and provides the necessary inlet valve.

0071453 11-Jun-03 04:37

Preferably, the arrangement is also provided with a lock to prevent the outlet valve from opening accidentally. The lock may be a bar fitted to the base, which can be swung into a position whereby the bar retains the resiliently deformable abutment surface of the upper part in contact with the opposing surface, thereby preventing fluid passing through the outlet if pressure is applied to the chamber.

A sealing engagement between the two parts is also preferable. In particular, it is preferable that the edge of the upper part is provided with a male ridge and the base is provided with a female groove, which forms a sealing engagement with the male ridge, or vice versa.

The base and the upper part are preferably moulded together within the same moulding tool in a bi-moulding process. The base may be moulded in a first stage and the upper part then moulded in a second stage of the operation. The upper part and the base are then fitted together to form the assembled nozzle arrangement.

It is especially preferred that the base is moulded first from a rigid plastic material together with a framework support for the upper part. The framework for the upper part is preferably connected to the base by a hinged or foldable connection member, which enables the framework to be folded over and fitted to the base during the assembly of the final product. Prior to folding the framework over and fitting it to the base, however, the framework is over

moulded with a compatible flexible, resiliently deformable plastic material. The resiliently deformable plastic material will thus form, in preferred embodiments, an upper wall of the chamber and an abutment surface of the outlet valve. It may also extend over other parts of the nozzle surface to provide a soft-touch feel to the device when an operator grips it. The rigid framework of the upper part may form an outer edge of the upper part, which forms the point of connection with the base and, in embodiments where a spray nozzle passageway is present, the framework may also form an upper abutment surface which contacts a lower abutment surface formed the base to define the spray passageway and outlet orifice. The upper part may be permanently fixed to the base by, for example, ultrasonically welding the two parts together. Alternatively, the resiliently deformable upper part may be configured to fit to the base to form a tight seal in the absence of any welding, or may be stretched over the base to form an airtight cover. The upper part may also remain separable from the base so that they can be separated during use to enable the chamber and outlet valve to be cleaned.

As an alternative, the flexible, resiliently deformable upper part may be fitted to the base by, for example, fitting the edges of the upper part into a receiving and retaining groove. Once in place, the framework of rigid material can then be fitted into place to lock the upper part to the base.

0071453 11-Jun-03 04:37

In some cases, the chamber will be deformed from the expanded configuration to the compressed configuration by the direct application of pressure by an operator's finger or thumb.

Alternatively, however, a hinged trigger member extending across the external surface of the resiliently deformable portion of the body and having a free end and an opposing end that is connected to the nozzle arrangement by a hinge may be used to deform the resiliently deformable portion of the body and hence, compress the chamber. The free end of the hinged trigger member can be pulled towards the nozzle arrangement to deform the resiliently deformable portion of the body, thereby causing the contents of the chamber to be ejected from the nozzle arrangement together with the contents of the pressurised container, and then released to stop the ejection and allow the resiliently deformable portion of the body to return to its original non-deformed configuration.

How the invention may be put into effect will now be described further by way of example only in reference to the following Figures, in which:

Figure 1A is a cross-sectional view taken through a first embodiment of a device of the present invention;

Figure 1B is an exploded cross-sectional view showing the components which make up the device shown in Figure 1A;

Figure 2A is a cross-sectional view taken through a second embodiment

0071453 11-Jun-03 04:37

of a device of the present invention;

Figure 2B is an exploded cross-sectional view showing the components which make up the device shown in Figure 2A;

Figure 3A is a cross-sectional view of the housing 102 shown in Figures 2A and 2B;

Figure 3B is a plan view of the underside of the housing 102 shown in Figures 2A and 2B;

Figure 4 is a plan view of the base 101 shown in Figure 2A;

Figure 5A is a cross-sectional view of the plunger 108 shown in Figures 2A and 2B;

Figure 5B is a plan view of the plunger 108 shown in Figures 2A and 2B;

Figures 6A and 6B are both cross-sectional views showing the top portion of the housing shown in Figure 2A and 2B nozzle outlet with the lid 104 partly displaced from the housing (Figure 6A) and in contact with the housing 102 (Figure 6B);

Figure 7A is a cross-sectional view of the nozzle outlet 106 shown in Figures 2A and 2B;

Figure 7B is a perspective view of the recess 704 shown in Figure 7A;

Figure 7C is a cross-sectional view taken along line X-X' of Figure 7A

in an assembled nozzle outlet;

Figure 8 is a cross-sectional diagrammatical view taken through the upper portion of the housing 102 of an alternative embodiment of the present invention which incorporates an alternative version of the second valve;

Figure 9A is a cross-sectional diagrammatical view showing a portion of an embodiment of a device of the present invention comprising an air leak;

Figure 9B is a cross-sectional diagrammatical view showing a portion of an alternative embodiment of a device of the present invention comprising an air leak;

Figure 9C is a cross-sectional diagrammatical view showing a portion of an alternative embodiment of a device of the present invention comprising an air leak;

Figure 10A is a cross-sectional view of a device of the present invention which is fitted with a trigger actuator; and

Figure 10B is a cross-sectional view of the device shown in Figure 8A when the trigger has been pulled to cause the housing to move relative to the base.

In the following description of the Figures, like reference numerals will be used to denote like or corresponding parts in different Figures.

A first embodiment of a device 100 according to the present invention is

0071453 11-Jun-03 04:37

shown in Figures 1A and 1B. The device 100 comprises a base 101 which comprises a cavity 150 having a screw thread formed in the internal wall thereof. This internal cavity 150 is adapted to receive a corresponding shaped screw threaded neck of a container, thereby enabling the device 100 to be screwed onto a container for use. The device further comprises a housing 102 which is slidably mounted within a recessed groove 103 formed on the upper surface of the base 101. The base is provided with an inwardly projecting rim 101a which abuts against an outwardly projecting rim 102a formed on the housing 102 to prevent the housing from sliding out of engagement with the base during use and thus, limits the extent to which the housing can slide upwards relative to the base.

The housing 102 defines an internal chamber 107 in which a plunger 108, which is seated on the base 101, is positioned. The plunger 108 extends across the entire width of the chamber 107 and forms a tight seal with the wall of the chamber formed by the housing 102. The plunger 108 also has an integrally formed, downwardly extending valve member 108a, which is received within a valve seat 109 formed in the base 101. The valve member 108a, together with the valve seat 109, form the so-called first valve of the device between the chamber and the interior of the container. An inlet channel 110 is also formed in the base 101 and a dip tube (not shown) is fitted to this channel to enable the contents of the container to be drawn into the chamber of the device through the first valve during use of the device.

0071453 11-Jun-03 04:37

The housing 102 further comprises a lid 104. The lid 104 is provided with a resiliently mounted flap 105 which fits over an outlet 105a of the chamber 107 to form the second valve. The lid 104 also has an abutment surface which is contacted with an abutment surface formed on the upper surface of the housing 104. These two abutment surfaces have various recesses formed therein which, when the surfaces are contacted together define a nozzle outlet 106 of the device. The nozzle outlet 106 is discussed further below in reference to Figures 7A, 7B and 7C.

A coiled spring 111 is positioned within the chamber 107. The spring is biased at one end against the housing 102 and the base 101 at its other end. The housing additional comprises a support member 102b which extends downwards from its upper surface and is positioned inside the bore defined by the coiled spring 111. The support member 102b provides support to the spring and also enables the spring to be kept in place while the device is assembled.

The spring forces the housing upwards relative to the base so that the rim 102a of the housing abuts the internal rim 101a of the base. In this position (and as shown in Figure 1A) the internal chamber 107 is expanded to its maximum internal volume. During use, the lid 104 of the housing 102 can be pressed downwards by an operator so as to cause the housing 102 to slide relative to the base 101, against the action of the spring 111. During this process, the internal volume of the chamber 107 is reduced and this in turn

0071453 11-Jun-03 04:37

compresses the contents present within the chamber. The resultant increase in pressure pushes the valve member 108a of the plunger into a sealing engagement with the valve seat 109, thereby closing the first valve and preventing the contents of the chamber flowing from the chamber 107 into the interior of the container. Once the pressure within the chamber reaches a predetermined minimum threshold value, for example 5 bars, the contents of the container cause the resiliently mounted flap 105 positioned over the chamber outlet 105a to be displaced from a position in which the outlet is blocked to a position in which the outlet is open, thereby enabling the contents stored within the chamber 107 to flow through the second valve and then be dispensed from the device through the nozzle outlet 106.

Once the desired amount of product has been dispensed or the housing has been depressed to its fullest extent so that the maximum quantity of product has been dispensed from the chamber, then the operator will release the pressure applied to the housing and the housing will slide back to its initial position shown in Figure 1A under the action of the spring 111. In doing so the internal volume of the chamber 107 is expanded and this creates a reduced pressure within the chamber. The second valve is closed during this process because once the pressure falls below the minimum threshold, the resiliently mounted flap 105 returns to the position in which it covers the outlet 105a. The reduced pressure within the chamber 107 causes the first valve to be opened, i.e. the valve member 108a of the plunger 108 is displaced from the valve seat

0071453 11-Jun-03 04:37

110 and the contents of the container are drawn into the chamber 107 to replenish the contents previously dispensed.

In a preferred embodiment, the plunger would be replaced with the plunger shown in Figure 9C, thereby providing the device 100 with an air leak valve.

Referring to Figure 2A and 2B, there is shown a second embodiment of a device 200 of the present invention. This second embodiment is the same as the embodiment shown in Figure 1 in many respects and this is illustrated by the use of the same reference numerals to denote like or corresponding parts. There is, however, one principal difference in that the housing 102 is formed to define a chamber 107 that is composed of two separate, internally sealed compartments. The central compartment 107a is equivalent to the chamber 107 shown in Figure 1 in that the contents of the container pass through it during the first and second stages of use previously discussed. The circular wall 201 of the housing 102 defines the central compartment 107a. This wall 201 is received within a corresponding circular recessed groove 202 formed in the upper surface of the base 101. Thus, during use the wall 201 slides within the recessed groove 202. The chamber 107a comprises a smaller plunger 108 and a spring 111, the functions of which are identical to that described in reference to Figures 1A and 1B.

The second compartment defined by the housing 102 is an air

0071453 11-Jun-03 04:37

compartment 203 which surrounds the central compartment 107a. The air compartment 203 is defined between the outside wall of the housing 102 and the inner wall 201. An air plunger 204 is seated on the base within the air compartment 203 and performs the same function as the plunger 108 describe in reference to Figure 1. In this embodiment, the air plunger 204 is circular and comprises a recess 205 formed in its under surface which, when seated onto the base in the final assembly, as shown in Figure 2A, receives the upright protrusion 206 formed on the base. A plan view of the upper surface of the base 101 is shown in Figure 4 to illustrate the arrangement of the respective recesses and protrusions.

In alternative embodiments of the invention, the housing 102 may be wider than the base and configured so that the outer wall of the housing slides over the outer wall of the base. This construction is preferred for embodiments of the invention which comprise an air leak, as discussed further below in reference to Figure 9C.

For the purpose of illustration, housing 102 of the embodiment shown in Figure 2 is shown in Figures 3A and 3B. Referring to these Figures, it can be seen that the housing has two outlets formed in its upper surface, namely a channel 301 through which the contents of the container to which the device is attached flow into the opening 105a during use, and a channel 302 through which the contents of the air compartment 203 are ejected during use into the nozzle outlet defined between the lid 104 and the upper surface of the housing

0071453 11-Jun-03 04:37

102.

The plunger 108 of the embodiment shown in Figures 2A and 2B is shown in more detail in Figures 5A and 5B. The upper portion of the plunger 108 is shaped to form two tight sealing engagements with the wall 201 of the central chamber 107a when positioned within the assembled device, as shown in Figure 2A. Specifically, a first seal, which prevents air leaking past the plunger during the second stage of operation, is formed by the edge 501 contacting the wall of the housing 201. A second seal, which prevents air leaking past the plunger during the first stage of operation, is formed by the contact of the edge 502 with the housing 201. If the second seal was not present, the edge 501 could be displaced from contact with the housing during the first stage of operation of the device by the pressure difference between the interior of the compartment and the outside environment, thereby causing air to flow into the compartment 107a, instead of product being drawing in through the first valve. The plunger also has a downwardly extending valve member 108a in the form of a truncated cone which is received within the aperture defined by the valve seat 109 of the base 101 to form the first valve.

The upper portion of the housing 102 is shown in more detail in Figures 6A and 6B. Fitted to the upper part of the housing 102 is a lid 104. The lid is composed of two parts, a body 601 which is adapted to be fitted to the upper portion of the housing 102 and a hinged lid portion 602. The hinged lid portion 602 has the resiliently deformable flap 105 formed on its under surface which,

0071453 11-Jun-03 04:37

when the lid is brought together with the body 601, forms the second valve, as discussed previously. The hinged lid portion 602 also has an abutment surface having grooves and/or recesses formed thereon which, when the lid is contacted with a corresponding abutment surface formed on the upper surface of the housing 102 which has corresponding grooves and/or recesses formed thereon, defines the nozzle outlet 106.

A plan view of abutment surface of the upper surface of the housing 102 is shown in Figure 7A. The abutment surface 701 comprises the outlet channel 301 of the housing through which fluid accesses the second valve and a groove 702 which extends from the second valve to an outlet 703. Formed within the groove 702 is a deepened recess 704. The recess 704 is shown in more detail in Figure 7B where it can be seen that the recess is semicircular in cross-sectional profile and the channel 302 that extends from the air compattment of the chamber defined by the housing to the nozzle outlet opens into this recess. The abutment surface of the lid 602 (not shown) comprises a similar grove to the groove 702 with an equivalent a recess equivalent to the recess 704 formed therein. Thus, when the two abutment surfaces are brought into contact, the grooves and recesses formed therein align to form a fluid flow passageway which extends from the second valve to the outlet 703 of the device and comprises a circular chamber formed by the alignment of the recess 704 and the corresponding recess of the abutment surface of the lid 602. The chamber thus formed is known as an expansion chamber. In use, the contents of the

0071453 11-Jun-03 04:37

container, which is usually a fluid, passes through the second valve into the passageway formed by the groove 702 and its equivalent on the opposing abutment surface of the lid. The fluid is then sprayed into the expansion chamber (see reference 710 in Figure 7C) formed by the recess 704 and the corresponding recess in the opposing abutment surface of the lid through an orifice formed in the passageway (not shown). The spray droplets thus formed mix with an air stream ejected from the air compartment in the expansion chamber and then continue along the passageway to the outlet where they are ejected from the device in the form of a spray.

To prevent the occurrence of leaks, the fluid outlet arrangement is surrounded by a horseshoe-shaped recess 705 formed in the abutment surface of the housing 102 which receives a correspondingly shaped protrusion 706 (see Figure 7C) formed on the abutment surface of the lid, as shown in Figure 7C, to form a horseshoe-shaped seal barrier. In a similar manner, further recesses 707 extend from either side of the horseshoe-shaped recess 705 towards the groove 702 at various points along the length of the groove 702. These further recesses also receive correspondingly shaped protrusions on the abutment surface of the lid and, together with the horseshoe-shaped seal barrier, define a series of internally sealed compartments around portions of the fluid flow passageway when the abutment surfaces of the upper surface of the housing 102 and the lid 602 are brought into contact. Any fluid that leaks from the fluid flow passage during use is then trapped within one of these

0071453 11-Jun-03 04:37

compartments and prevented from seeping between the abutment surfaces and leaking from the nozzle outlet.

The channel 302 is shown in Figures 7A and 7B as a direct channel between the air compartment 203 (not shown) and the fluid flow passage of the nozzle outlet. Where the nozzle outlet is formed between the abutment surfaces of two or more parts, as shown in Figures 7A and 7B, it shall be appreciated that the air can be conveniently channelled to virtually any point along the length of the fluid flow passage that is desired by, for example, directing the air stream along the horseshoe-shaped seal (in a channel formed between the bottom of the horseshoe-shaped recess formed in one abutment surface and the upper edge of the horseshoe-shaped protrusion formed on the opposing abutment surface and then re-directing the air stream through a channel, which is preferably formed in a similar manner to the channel in the horseshoe-shaped seal, into the fluid flow passage. Alternatively, the air may be directed to the desired location in the nozzle outlet through a channel that is formed in a similar manner to that previously described (but without being directed along the horseshoe-shaped seal).

Figure 7C is a cross-sectional view taken along line X-X' of Figure 7A. In Figure 7C the horseshoe-shaped recesses 705 and the horseshoe-shaped protrusion 706, which form the horseshoe shaped seal are visible on either side of the expansion chamber 710. The fluid flow passage 711 which opens to the expansion chamber 710 is also shown.

0071453 11-Jun-03 04:37

An alternative embodiment of the cap 104 is shown in Figure 8. In this embodiment, the cap 104 is fitted to the upper end of the housing 102 shown in Figures 1A and 1B in the usual manner. The channel 301, through which the product flows when it is ejected from the chamber 107, is covered by a resiliently deformable membrane 801, which is integrally formed in the lid 104, and has a downwardly extending post 802 which is received within the upper portion of the channel 301. This membrane effectively forms an alternative form of the second valve of the device. During use, i.e. when the housing is pushed downwards to eject the contents of the chamber through the nozzle outlet during the second stage of operation, the pressure within the chamber increases to a predetermined threshold level and, once this level is attained, the membrane 801 deforms away from the channel 301 withdrawing the post 802 to form an opening through which the contents of the container may access the nozzle outlet 106. After use, i.e. when the pressure falls below the threshold value, the membrane returns to its original position in which the channel 301 is closed, as shown in Figure 8.

Figure 9A shows a modification to the air plunger 204 and base 101 shown in Figures 2A and 2B which provides an air leak to equalise any pressure differential that develops between the interior of the container and the external environment. Only the relevant portion of the device is shown in Figure 9A for the purpose of illustration. As previously discussed in reference to Figures 2A and 2B, the housing 102 is slidably mounted in a recess 103 of

0071453 11-Jun-03 04:37

the base 101 and an air plunger 204 is seated on a protrusion ridge 206 formed in the base 101. As shown in Figure 9A, the air plunger 204 is modified to include a downwardly extending resiliently mounted arm 901 which contacts the internal wall of the housing.. The resiliently mounted arm 901 is positioned adjacent an air leak opening 902 formed within the base and is capable of movement between a position in which said arm covers and closes the air leak opening and a position in which the air leak is open, thereby enabling air to flow between the external environment and the interior of the container. As can be seen in Figure 9A, the resiliently mounted arm 901 of the plunger 204 can be urged into the closed position by an enlarged annular rim 903 at the base of the internal wall of the housing 101, which urges the resiliently mounted arm into a position in which the air leak is closed when the device is not in use and the housing is displaced upwards relative to the base of the spring. During the second stage of operation when the housing is pushed downwards relative to the base, the arm 901 of the air plunger 204 tends to still seal the opening 902, whereas when the housing moves upwards relative to the base during the first stage of operation, the arm 901 is displaced from the opening 902 and air can pass through the opening until the rim 903 urges the arm 901 back towards the opening to reform the seal.

Figure 9B shows yet another alternative embodiment of the device of the present invention which comprises an air leak formed therein. The embodiment shown in figure 9B is similar to that shown in Figures 2A and 2B in certain

0071453 11-Jun-03 04:37

respects. However, this embodiment differs in that the central compartment 107a of the chamber is provided with a plunger of different construction to the plunger 108. In this embodiment, the plunger in the central cavity 107a is shown by the reference 910 and a separate valve member 911 is received within the valve seat 109 of the base 101 to form the first valve. A ledge or set of post 912 onto which the spring 111 is mounted is provided between the valve member 911 and the plunger 910. A further modification is that the second valve is formed by a resiliently deformable membrane 801 having a downwardly extending member 802 which is received within the outlet channel 301, rather than the flap 105 which covers the opening 105a previously described.

The air plunger 204 is also of a different form but, in common with the embodiment shown in Figure 9A, comprises a resiliently mounted arm 901 which is also capable of being urged from a position in which the arm is displaced from an air leak opening 902 formed in the base and the air leak is open, to a position in which the air leak 902 is closed. Again, the arm 901 of the air plunger 204 is urged into the position whereby the air leak 902 is closed when an enlarged rim 903 formed at the base of the internal wall of the housing 102 slides past the arm 901. Hence, when the housing is pressed down relative to the base, as shown in Figure 9B, the air leak is open, but if the housing is released so that the spring 111 pushes the housing upwards until the rim 102a abuts the rim 101a, then the arm is urged into the position whereby the air leak

0071453 11-Jun-03 04:37

is closed by the enlarged rim 903.

Figure 9C shows a further alternative embodiment of the device, which comprises an air leak. In this embodiment, the outer wall of the housing slides over the outer surface of the base when the housing is pushed down relative to the base, rather than being slidably mounted within a recessed groove formed in the upper surface of the base, as in all of the previous embodiments. In this embodiment, the air plunger 204 is in the form of a wedge which possesses two arms. A first arm 901 contacts the side of the base to form a seal to close the air leak 902 formed in the base, whereas the second arm 920 forms a tight sealing engagement with the internal wall of the air compartment 203. The seal formed by the arm 901 is only very light and this are can be deflected to a position in which the air leak is open if the external pressure exceeds the pressure within the container. The leakage of the contents of the container out of through the air leak 902 is prevented, however, because the arm 902 forms a seal against the wall of the base as shown in Figure 9C and cannot be deflected further to enable flow to occur out of the container.

Figures 10A and 10B show a container 1000 fitted with a device 100 of the present invention which is provided with a trigger actuator 1001. The trigger actuator 1001 is composed of two pivotally connected parts 1002 and 1003 connected together by a plastic hinge at 1004. Part 1002 consists of an attachment element 1002a which is pivotally connected to the base of the device and a trigger 1002b which can be operated by a user in the normal

0071453 11-Jun-03 04:37

manner. Part 1003 is pivotally mounted to the lid 104 of the housing 102. Operation of the trigger by pulling it towards the container pulls the part 1002 downwards about the pivotal connection to the base and his action causes the part 1003 to pull the housing downward relative to the base, thus compressing the chamber therein and causing the product, or a mixture of product and air, to be dispensed through the nozzle outlet. It will be appreciated that many other forms of trigger actuator could be prepared and the present invention is not to be considered limited to the specific embodiment described.

0071453 11-Jun-03 04:37

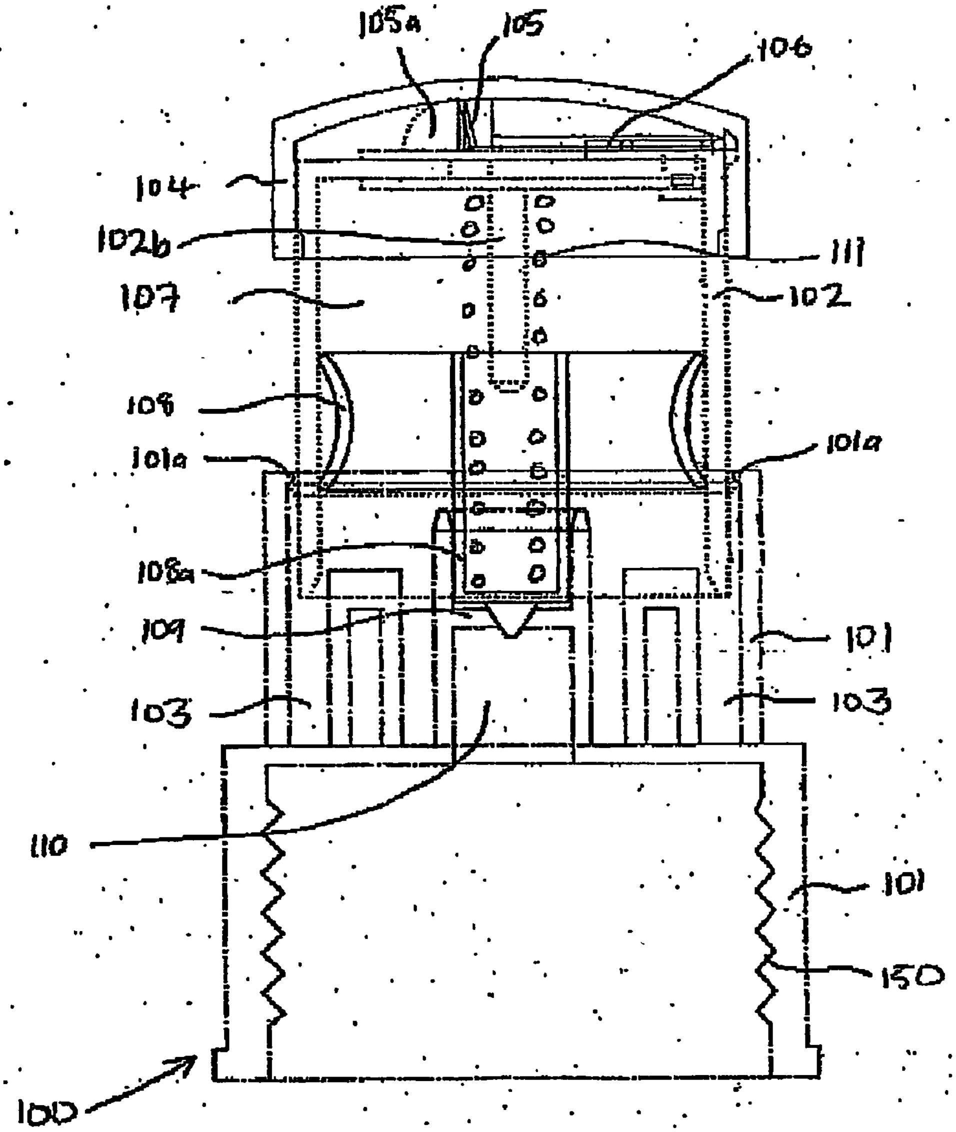

Figure 1A

0071453 11-Jun-03 04:37

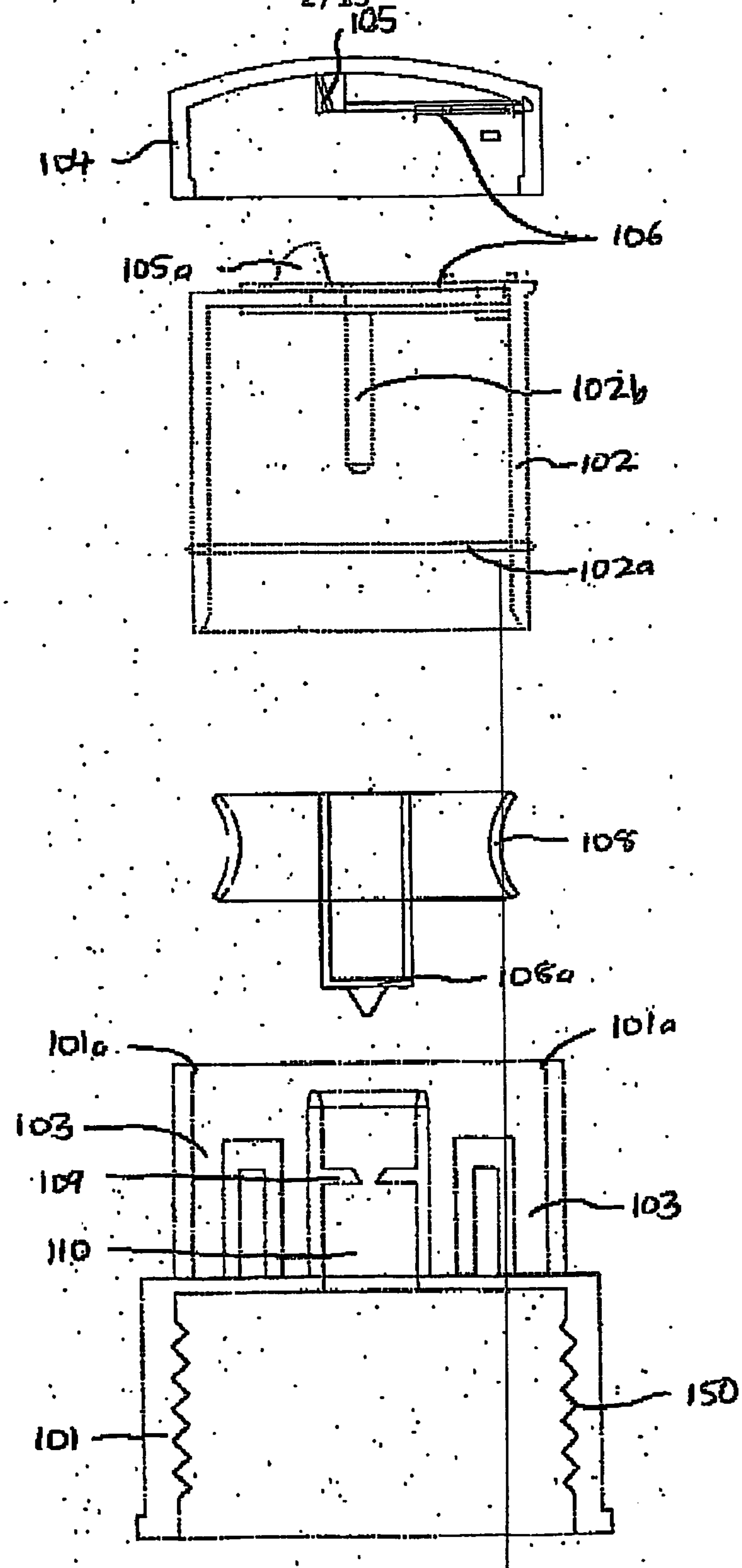

Figure 1B

0071453 11-Jun-03 04:37

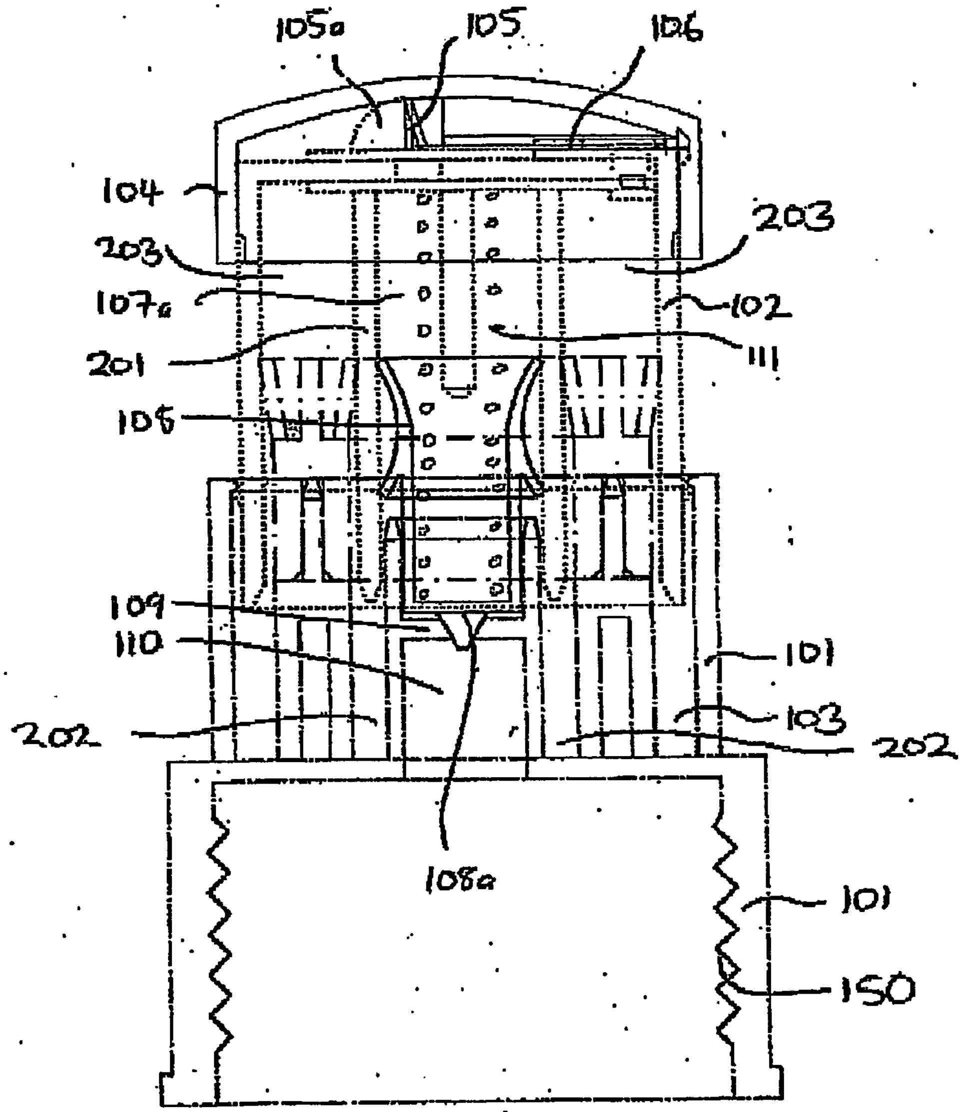

Figure 2A

0071453 11-Jun-03 04:37

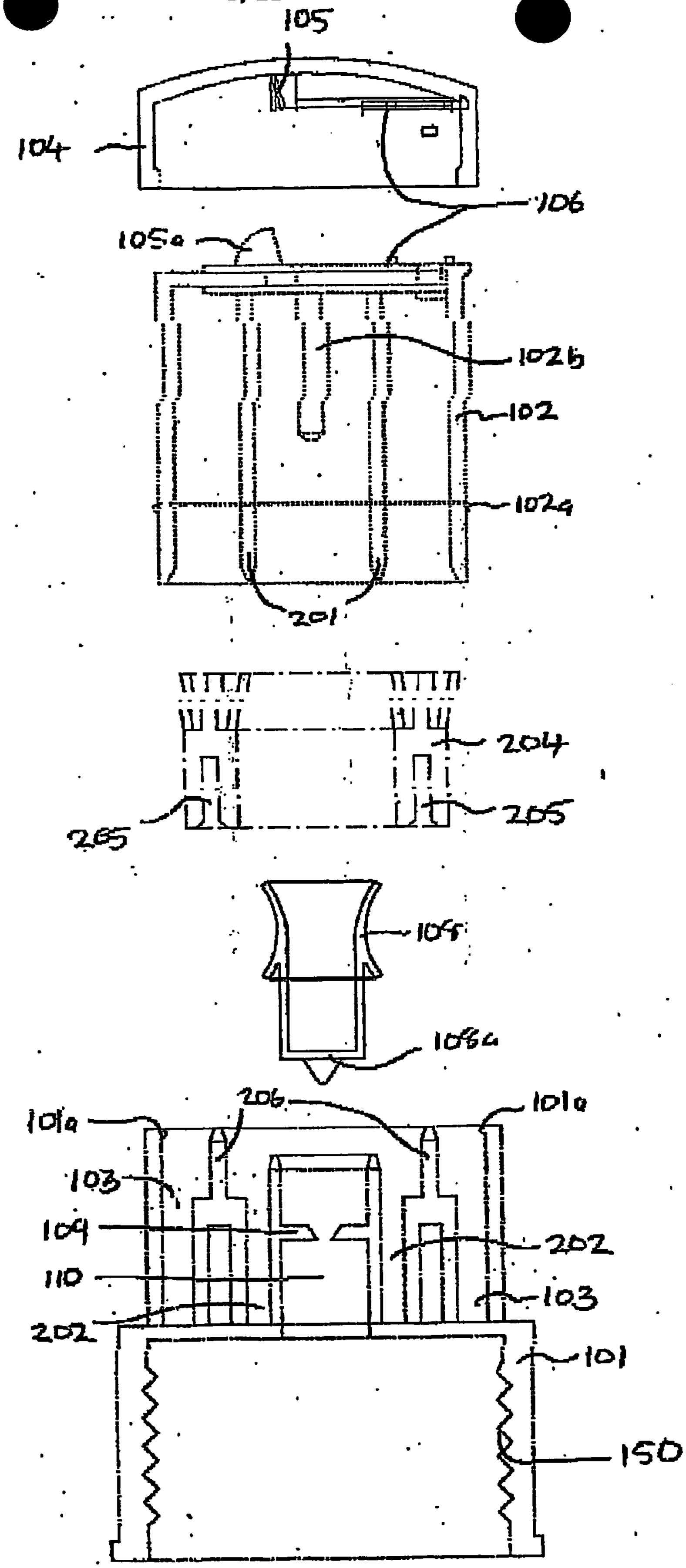

Figure 2B

0071453 11-Jun-03 04:37

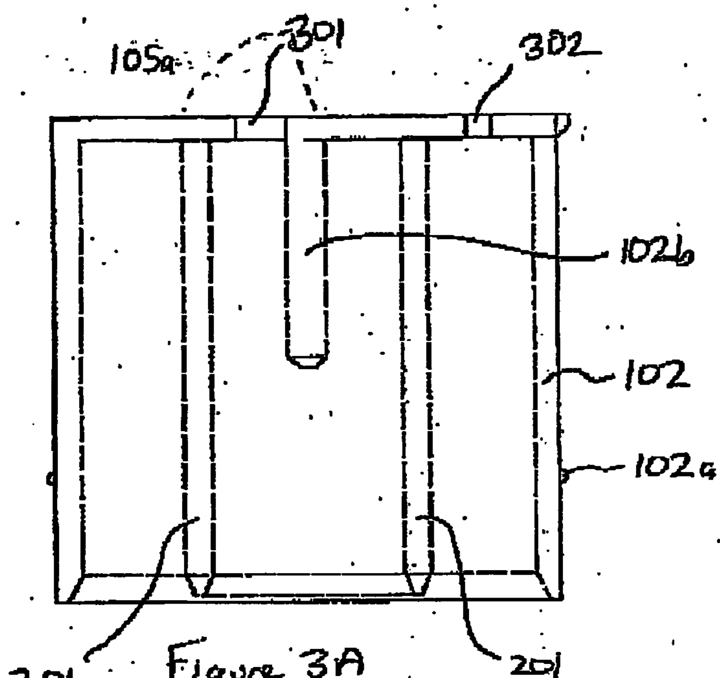

Figure 3A

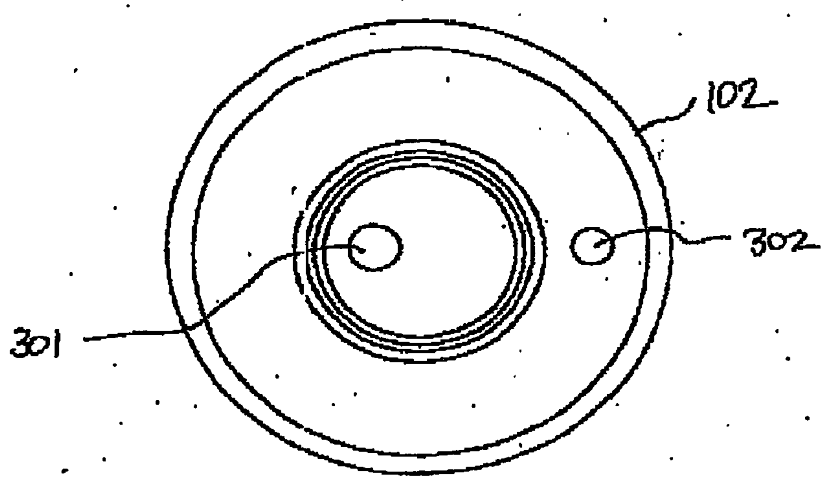

Figure 3B

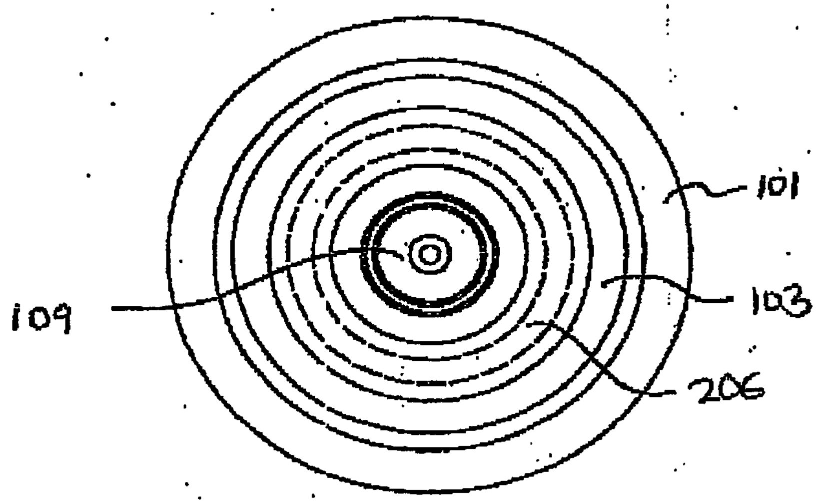

Figure 4

0071453 11-Jun-03 04:37

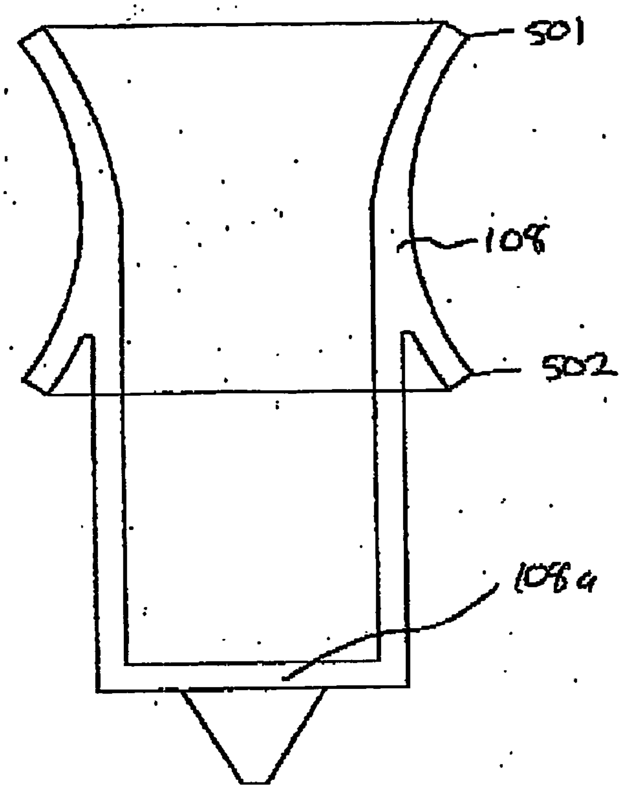

Figure 5A

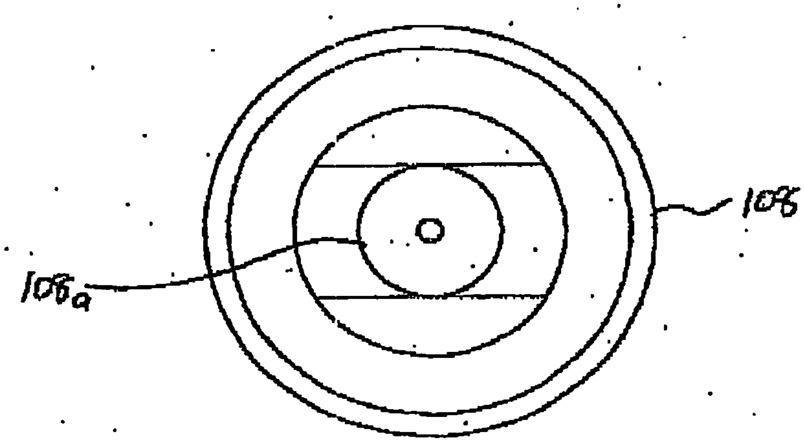

Figure 5B

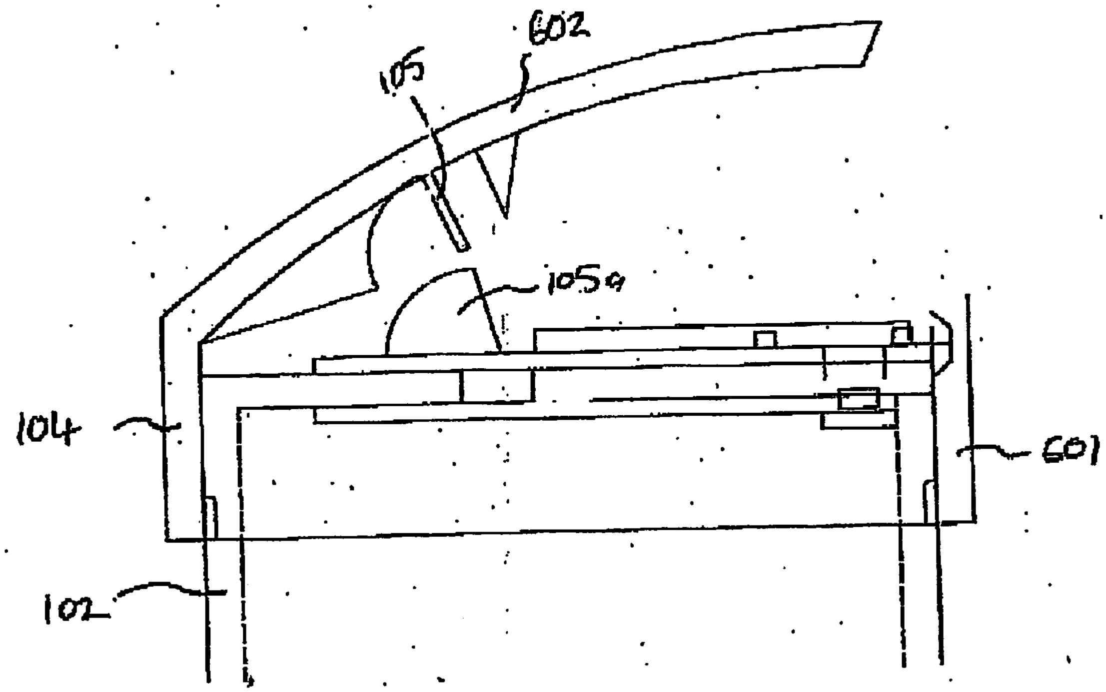

Figure 6A

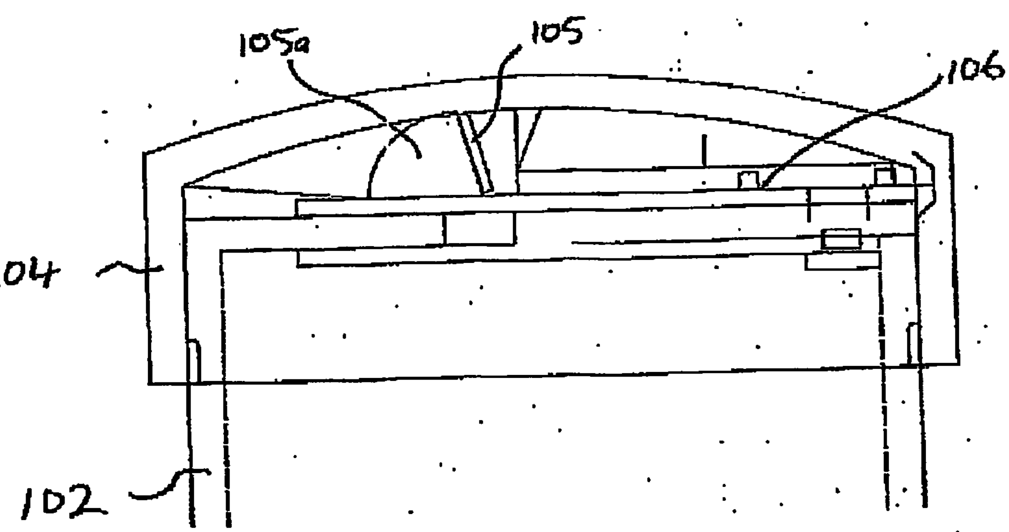

Figure 6B

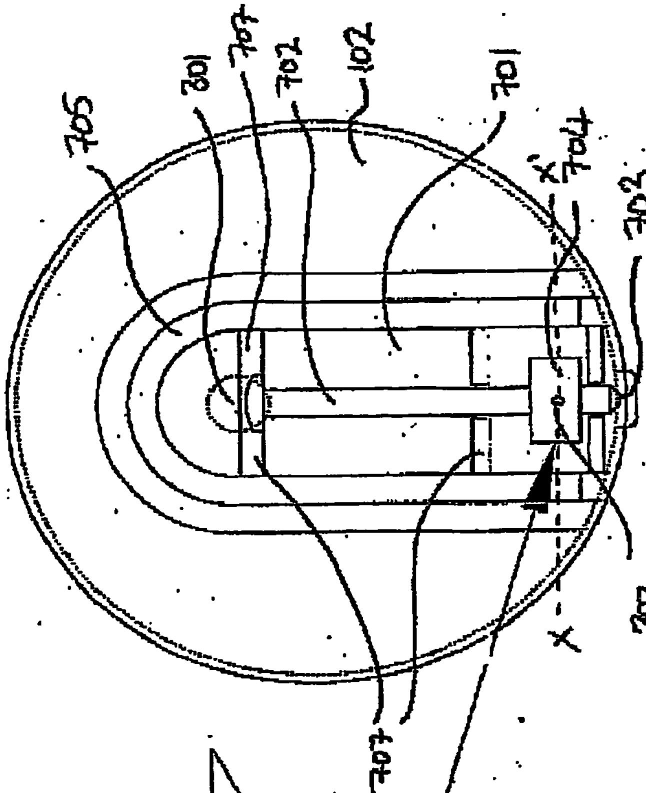

Figure 7A

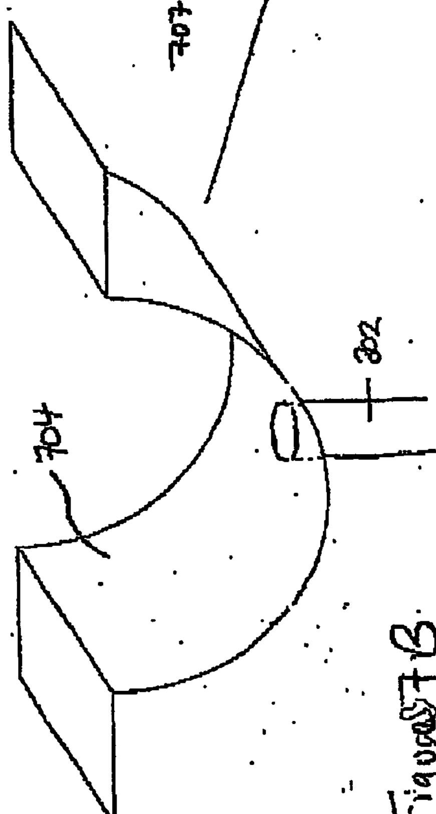

Figure 7B

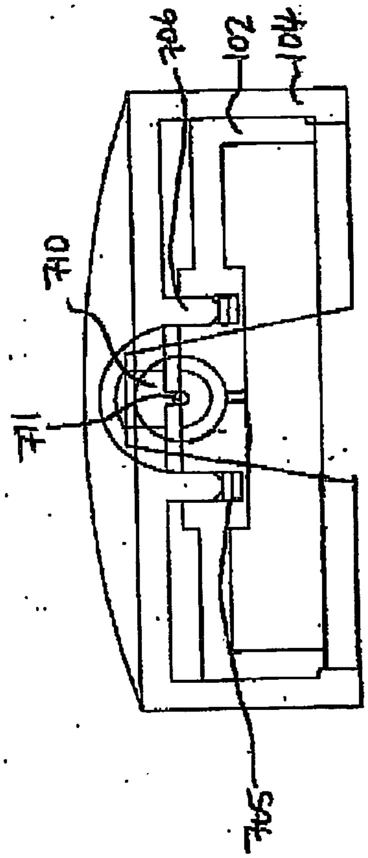

Figure 7C

0071453 11 Jun 03 04:37

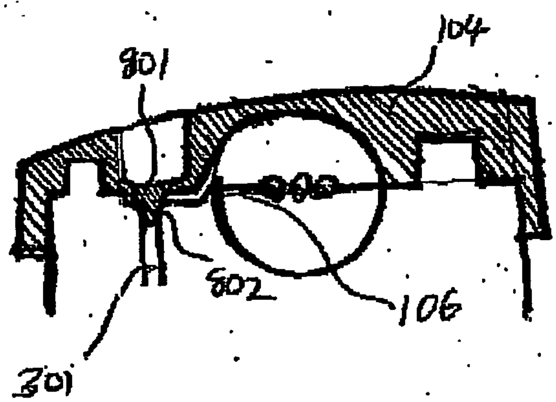

Figure 8

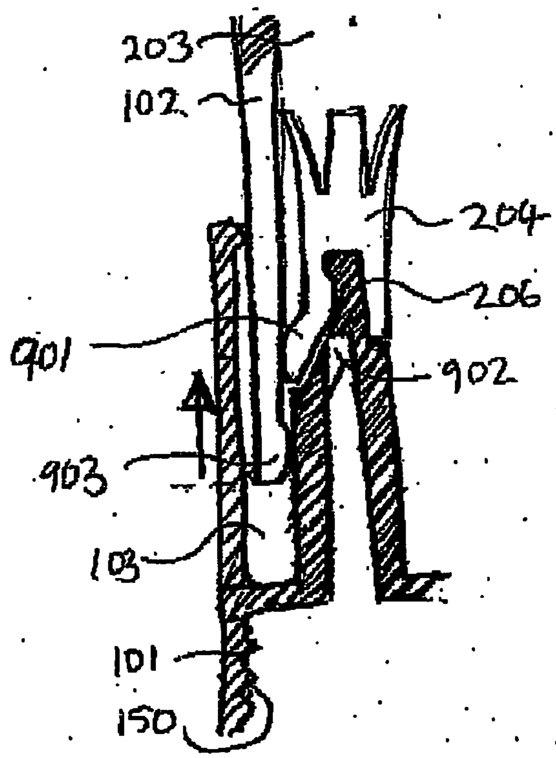

Figure 9A

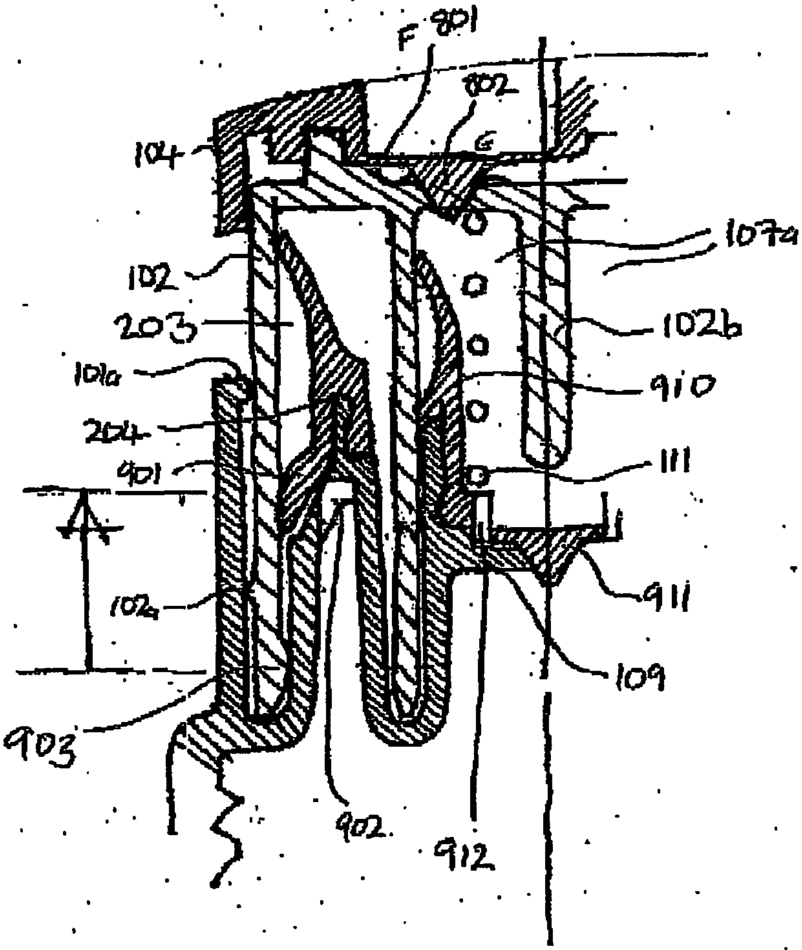

Figure 9B

0071453 11-Jun-03 04:37

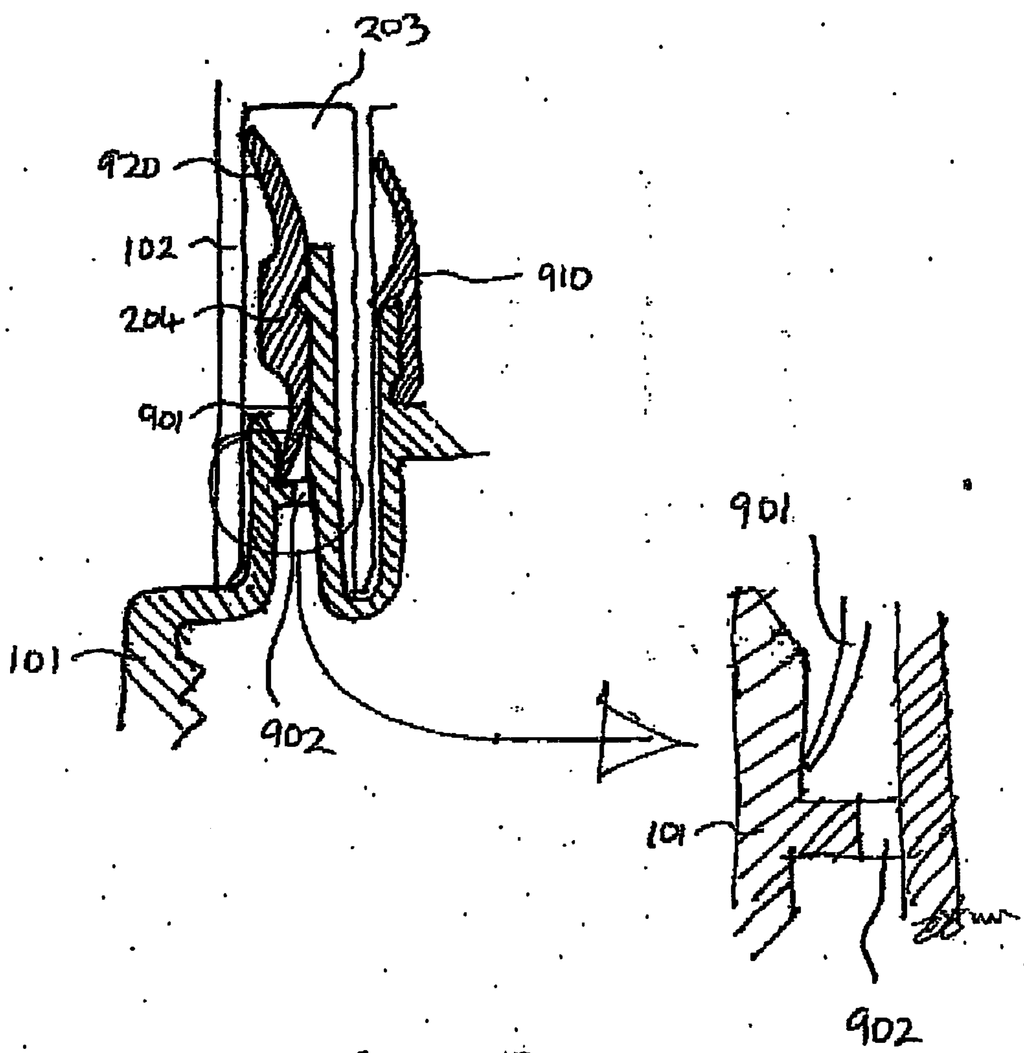

Figure 9C

0071453 11-Jun-03 04:37

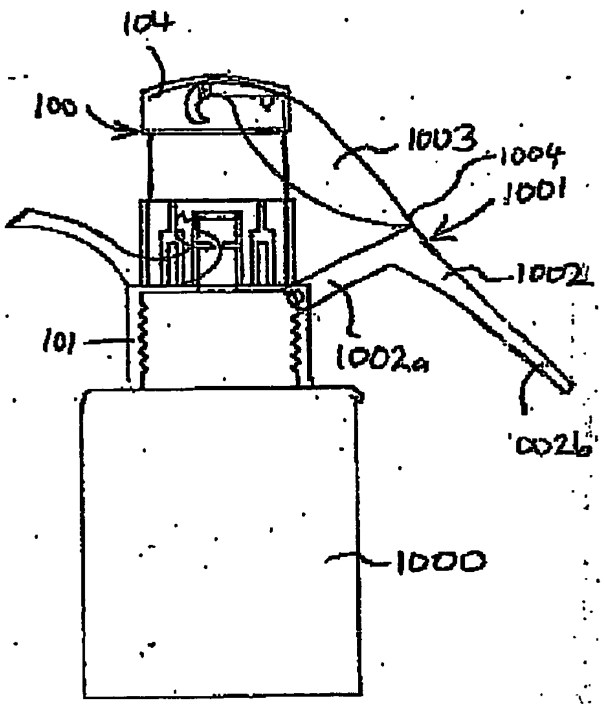

Figure 10A

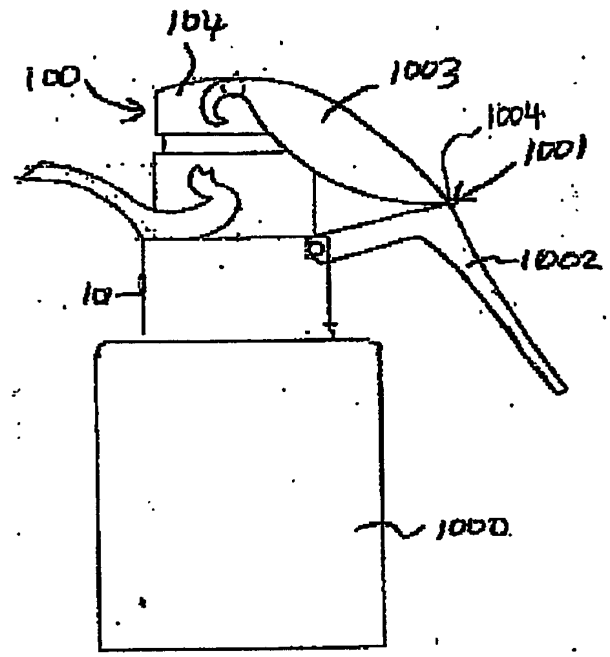

Figure 10B

0071453 11-Jun-03 04:37

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☑ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☑ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☑ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: ______________________

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.